



# LIVING ON THE FRONT FOOT IN BIO WARFARE ERA

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## ABSTRACT

Bioterrorism is a realistic threat to the security and well-being of all countries. All war in modern times contains elements of terrorism. *There are known knowns.* Undisclosed warnings attract a great deal of guesswork. The intercontinental affairs of the last two vicennial specify that the threat of biological warfare is not a myth, but a harsh reality. Biological warfare, also known as germ warfare. Bio warfare attacks are now a possibility. 500 million people died of infectious diseases during the last hundred years. Thousands of deaths were due to the liberation of toxins and pathogens during the Second World War.

Global terrorism is a quickly spread warning signal to the universal security, and increases the chance of bioterrorism. It is the use of biological toxins or infectious agents with the object to kill, harm or incapacitate humans, animals or plants as an act of war. Bio terrorism is using pathogenic organisms or toxins, to cause harm to humans, animals, or plants. Terrorism is the violence to generate fear and terror to bring about financial, religious, or political aim. Biological warfare, agents are lethal than other conventional weapons in smaller quantities.

**KEY POINTS:** Bacillus anthracis, Yersinia pestis, Coxiella burnetii, Rickettsia rickettsii, Francisella tularensis, Rickettsia prowazekii, Variola Major, Vibrio cholerae, Clostridium botulinum, Staphylococcus aureus, Bioterrorism, biodefense strategies, policy measures.

## INTRODUCTION:

Bioweapons are as effective and their ability to conflict with high levels of morbidity and mortality (1)

Bioweapons are also extremely cheap to produce compared with nuclear weapons which require enriched radioactive elements (2)

Offensive biological warfare is prohibited under customary international humanitarian law and several international treaties. (3,4)

The use of biological agents in armed conflict is a war crime (5)

The agent of variola virus (VARV) belongs to the genus Orthopoxvirus (6)

The British used smallpox as a biological warfare agent at the Siege of Fort Pitt during the French and Indian Wars (7)

There are also accounts that smallpox was used as a weapon during the American Revolutionary War (8)

Biological arms are typically classified as weapons of mass destruction (9)

The bacterium Bacillus anthracis, as a biological weapon, used in biowarfare and bioterrorism since 1914 (10)

Francisella tularensis, is considered to be a dangerous potential biological weapon, an outbreak of tularemia occurred in Kosovo in 1999-2000 (11)

Smallpox, Ebola, and Marburg viruses chosen because they cause horrifying illness (12)

Ebolavirus is classified as a biosafety level 4 agent, and Category A bioterrorism agent by the Centers for Disease Control and Prevention (13)

It has the potential to be weaponised for use in biological warfare (14)

Deadly Ebola and Marburg viruses were collected from bats in Nagaland by Chi-

nese and US defense researchers in 2017 (15)

## HISTORY:

### Bioterrorism, in the last century:

- World War I: Germany launched a biological sabotage campaign in France, Romania, Russia, and the United States by infecting horses and mules with glanders
- World War II: Japanese biological weapons attacks in China, testing botulism, anthrax, and plague
- 1972: Two college students, Allen Schwander and Stephen Pera, were arrested for planning to poison the Chicago water supply with typhoid bacteria
- 1979: Anthrax leak from chemical weapons research facility, Sverdlovsk, Soviet Union
- 1984: The Bhagwan Shree Rajneesh followers in Oregon attempted to affect a local election by infecting doorknobs and salad bars in restaurants with Salmonella typhimurium bacteria
- 1993: Aum Shinrikyo religious group released anthrax in Tokyo
- 2001: Anthrax-laced letters of infectious anthrax were delivered to news media offices and the US Congress

### Biological warfare:

It is the international use of microorganisms, and toxins to produce disease and death in humans, livestock, and crops.

### Biological weapons:

Microorganisms, biologically derived, Biologically derived bioactive substances (BDBS)

### Artificially designed biologically mimicking substances.

CDC classified bioterrorism agents into three.

A. Can be easily spread or transmitted from person to person

1. Cause high death rate
2. Cause public panic
3. Requires special public preparedness

Eg. *Variola vera*, *Bacillus anthracis*, *Yersinia pestis*, *Francisella tularensis*, *Ebola*, *marburg viruses*, and *Lassa viruses*

B. Moderately easy to spread

Produce moderate and low death rate

Requires enhancement in diagnosis.

Eg. *Coxiella burnetii*, *Brucella spp.*, *Alpha virus*, *Recin*, *Clostridium perfringens*, *Staphylococcus aureus*, *Salmonella spp*

C. Easily available and easily spread.

Eg. *Nopha virus*, *Hanta virus*, *arbovirus*, *Mycobacterium tuberculosis*, *Flaviviridae*, *Ebola*, *Marburg*, and other hemorrhagic disease fever viruses

BW is the ability to use BAs as weapons. Bacteria, viruses, rickettsiae and fungi are the main kinds of BWAs. (16)

BAs that have been identified as posing the greatest threat are variola major (smallpox), *B. anthracis* (anthrax), *Y. pestis* (plague), *Clostridium botulinum* toxin (botulism), *F. tularensis* (tularemia), filoviruses (Ebola hemorrhagic fever and Marburg hemorrhagic fever) and arenaviruses Lassa (Lassa fever) and Junin (Argentine hemorrhagic fever) (17)

Based on the risk to national security, these agents have been prioritized into three categories

Agents classified as high-risk or category A can be easily disseminated or transmitted person-to-person, cause high mortality with potential for major public health impact, may cause public panic and social disruption and require special action for public health preparedness. The second highest priority or category B agents include those that are moderately easy to disseminate, cause moderate morbidity and low mortality and require enhanced disease surveillance. Category C includes emerging pathogens that could be engineered for mass dissemination in the future because of availability, ease of production and dissemination and potential for high morbidity and mortality and major health impact (18)

#### Black swan events:

"Black swans have happened before and will happen again.

#### Bacterial diseases:

1. *Bacillus anthracis*-----Anthrax----First world war, Second world war, Soviet Union 1979, Japan 1995, USA-2001
2. *Brucella suis*-----Brucellosis
3. *Yersinia pestis*-----Plague-----Fourteenth century Europe, Second world war
4. *Coxiella burnetii*---Q fever
5. *Rickettsia rickettsii*---Rocky Mountain spotted fever
6. *Francisella tularensis*---Tularemia----Second world war
7. *Rickettsia prowazekii*---Typhus
8. *Variola Major*---Smallpox-----Eighteenth century North America
9. *Vibrio cholerae*---Cholera---Second world war
10. *Clostridium botulinum*---Botulinum toxin
11. *Staphylococcus aureus*-----Enterotoxin--B
12. *Clostridium perfringens*---Epsilon toxin
13. *Shigella dysenteriae*---Shiga toxin---Second world war
14. *Salmonella typhi*-----Second world war
15. *Burkholderia mallei*----- (glanders),
16. *Burkholderia pseudomallei* ----(ulcers, abscess),

#### Viral Diseases:

1. Alpha virus--Second world war
2. Venezuelan equine encephalitis virus---Viral encephalitis
3. Ebola, Marburg, Congo-Crimean virus----Hemorrhagic fevers----Soviet weapon program
4. Rift valley, Lassa, Yellow fever virus----Fever
5. Hantavirus----Korean hemorrhagic fever
6. Tick-borne encephalitis virus ----Russian spring-summer encephalitis

#### Fungal diseases:

1. *Magnaporthe grisea*---Rice blast
2. *Puccinia graminis*---Rye stem rust
3. *Histoplasma capsulatum*----Histoplasmosis

#### Challenging the threat of bioterrorism:

1. Preparedness for intentional outbreaks will strengthen the response to naturally occurring epidemics
2. Health-care providers should maintain awareness of biological agents with bioterrorism potential and consider the presence of unknown pathogens
3. Emergency room and community physicians should be updated regularly about the clinical manifestations of diseases caused by potential bioterrorism agents and emerging infectious diseases.
4. Improved surge capacity (the ability to rapidly gear up the health system to cope with a sudden, large increase in patients with a serious, contagious disease) is required, particularly in peripheral areas
5. The capacity of general and reference laboratories should be increased, to keep developing faster, more reliable diagnostic tests
6. New and improved vaccines (pre-exposure and post-exposure) and treatment regimens should be developed
7. Syndromic surveillance systems can be maintained to register suspicious or confirmed cases reported by physicians, and the data can be used to improve risk communication programs and to monitor the progress of an outbreak
8. To improve preparedness for natural and bioterrorist outbreaks, international cooperation should include joint exercises involving multiple countries and constant improvement in the exchange

The real challenge for global safety remains the early detection, the accurate characterisation and the establishment of specific measures, whatever the outbreak origin. Both experts and Artificial Intelligence will have to learn how to work together and assist each other by developing collaborative intelligence.

#### Agents with high risk of occupational exposure:

Recently, infectious diseases have been found to be most frequent among occupational diseases. This review concentrates on literature published after 2010 that attempted to detect biological hazards to humans, especially workers, and the efforts to protect them against these factors. (19)

#### UN committee calls for global alert on bioterrorism in Covid times:

UN bodies, NATO Parliamentary Assembly, and Interpol, entrusted with the task of identifying non-state actors involved in bioterrorism, are carefully monitoring the response of terrorists to the effects of the current Covid-19 pandemic amid speculations that terror groups may have notions of spreading mass terror by using biochemical weapons, a media report said.

#### India's preparedness against bioterrorism:

IN the world of advanced weaponry and strategies, the threat of bioterrorism is of great concern not only to the safety of every country, but also to the health and wellbeing of its citizens.

A sound infrastructure is necessary for both medical, research and development to evolve novel instruments and methods of testing. Biological disasters cause economical disturbance and diminish of population. BW may cause mass destruction similar to chemical and nuclear weapons. Epidemics can result in substantial losses due to depletion of crops, domestic animals and human. A multi-disciplinary approach has to be adopted, for which judicial involvement of the government is a prerequisite. Acts related to management of environment, human, animal health, etc. have been enforced to punish criminals of such illegal activities. The Ministry of Health and Family Welfare (MoH and FW), the national health sectors are the main departments dealing with epidemics. It also provides directions and technical support in surveillance. This ministry helps in employment of Rapid Response Teams' manpower and support. The Ministry of

Defense (MOD) manages consequences of biowarfare. Clinical case management is supported by the Indian armed forces, as they have a number of hospitals around the country. They use ambulances, aircrafts and ships to handle casualties. The Defence Research and Development Organization (DRDO) is actively engaged in developing protective systems and equipment for troops to fight against nuclear, biological and chemical warfare.

#### Pathogens of greatest concern:

##### The anthrax attack:

The anthrax attack was relatively small and did not involve the use of multiple agents, multiple modes of transmission, a drug resistant organism, transmission to animals, or global spread. The surge capacity of the health-care delivery system was not challenged. In addition, unlike some of the other threat agents, the causative organism was easily isolated in clinical laboratories; there was no risk of person-to-person transmission and no risk of vector-borne transmission (20)

##### Brucella:

Brucella has the potential to be used as a biologic weapon, but to date, these organisms have not been implicated in any major bioterrorism incident. Were they used in such a way, however, patients might not present until several weeks later. (21)

##### The Plague attack:

It had killed 30% or more of afflicted populations, slowly playing itself out including the Great Plague of London in 1665. The third pandemic began in southwestern China in the mid-19th, struck Hong Kong in 1894. The pandemic caused 12 million deaths. Recent outbreaks in Madagascar and Uganda have triggered domestic turmoil, large-scale antimicrobial prophylaxis of case contacts and health-care workers, and concern for international spread. (22,23)

##### The Smallpox attack:

The threat of smallpox being used as a biological weapon in war was greatly diminished when a large part of the European population was vaccinated (24)

##### Francisella tularensis attack:

The Centers for Disease Control and Prevention (CDC) regard *F. tularensis* as a viable biological warfare agent, and it has been included in the biological warfare programs of the United States, Soviet Union and Japan at various times (25)

A former Soviet biological weapons scientist, Ken Alibek, has alleged that an outbreak of tularemia among German soldiers shortly before the Battle of Stalingrad was due to the release of *F. tularensis* by Soviet forces (26)

In the United States, using rabbit fever as a biological warfare agent at Pine Bluff Arsenal, Arkansas, an extension of the Fort Detrick program (27)

##### Ebola virus attack:

Ebola virus is classified as a biosafety level 4 agent, as well as a Category A bio terrorism agent by the Centers for Disease Control and Prevention (28)

It has the potential to be weaponized for use in biological warfare (29)

It was investigated by Biopreparation for such use, but might be difficult to prepare as a weapon of mass destruction because the virus becomes ineffective quickly in open air (30)

Fake emails pretending to be Ebola information from the WHO or the Mexican government have, in 2014, been misused to spread computer malware (31)

The BBC reported in 2015 that "North Korean state media has suggested the disease was created by the U.S. military as a biological weapon" (32)

##### Modern biological warfare:

Germany used biological warfare (BW) agents for sabotage, during World war 1. Horses brought consignment were infected with anthrax or glanders.

In 1941, the UK had developed anthrax as an agent against cattle. Canada did extensive work on rinderpest. The USA-UK-Canadian BW program was focused on anthrax as an antipersonnel weapon. It was abandoned before being finished (33)

##### Methods of detection of bio warfare agents:

Presently, antibody-based immuno-assays, biochemical testing, mass spectrometry, microbiological culturing and genomic analysis using PCR (used in Biowatch program of USA) are recommended for primary identification of biological agents and their specific genes<sup>23–25</sup>. These techniques are highly reliable, sensitive and selective.

However, some of the detection methods have drawbacks like difficulty in isolation, extraction and purification of samples for testing, poor detection capability in identifying differences in pathology.

1. Biological Culture

2. Immunological methods
3. Enzyme Linked Immunosorbent Assay
4. Hand-held Immuno-Chromatographic Assay
5. Nucleic acid based detection
6. Next Generation Sequencing
7. Cellular fatty based profiling
8. Matrix-assisted laser desorption/ionization-time of flight mass spectrometry Matrix-assisted laser de
9. Flow cytometry
10. Bio-sensors
11. Standoff detection technologies

#### The Role of the Clinical Microbiology Laboratory in Detection, and Confirmation of Biological Agents:

To be successful in this role, laboratory personnel, develop both laboratory- and institution-wide response plans. (i) criteria for distinguishing the type of bioterrorism event; (ii) information regarding access to and utilization of the Laboratory Response Network, including diagnostic testing protocols; (iii) safety guidelines; (iv) communication and notification protocols; (v) criteria for the safe packaging and transport of infectious substances; and (vi) measures to increase laboratory security (34)

Regular review of the management of bio terrorism is essential for maintaining readiness for these sporadically occurring events.

Professional microbiologists play a central role in the detection of agents associated with bio terrorism. Terrorists are likely to select an area that is the most vulnerable. Recognition of an outbreak is a group effort, given that people within a region will have the same symptoms at the same time. But communications between institutions needs to be augmented. Most clinical laboratories have access to the Laboratory Response Network (LRN), which was created to provide an organized response for the detection and diagnosis of biological agent.

#### Bioterrorism:

Biological agents or toxins that can eliminate or harm people, farm animals and crops. Biological substances during biological war can make you sick

#### Before a Biological Threat:

A biological attack may not immediately manifest. People would be alerted through an emergency radio or TV broadcast a telephone call

#### To prepare:

Make sure everyone in your family has up-to-date vaccines.

#### During a threat:

- Watch TV, listen to the radio or check the Internet for news. Note the information. For symptoms of the disease, areas in danger, vaccinations are being distributed
- Depending on the situation, wear a face mask to reduce inhaling or spreading germs.
- Follow official instructions for disposal of contaminated items.
- Wash yourself with soap and water and put on clean clothes. You may be advised to stay away from others or even to quarantine. Follow the instructions of doctors and other public health officials. Avoid crowds. Wash your hands with soap and water frequently.

#### CONCLUSION:

Bioterrorism is the deliberate release of viruses, bacteria, toxins or other harmful agents to cause illness or death in people, animals, or plants. Bioterrorism take advantage particularly on the nation's public health of the consequences of a bioterrorism attack. To meet the challenge of bioterrorism, coordinated with different agencies, viz. the intelligence agency, the army, the BSF, SSB, law enforcement machinery, health department, civil administration, etc. are required.(35)

A biological attack cause serious disruption to economic and societal infrastructure. Biological weapons possess destructive and loss of life. Laboratories are working on advanced detection systems to provide early warning, identify contaminated areas and populations at risk, and to facilitate prompt treatment.

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